



The Epidemiology of Tuberculosis in Minnesota 2018 – 2022

Minnesota Department of Health
Tuberculosis Prevention and Control Program
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The purpose of this slide set is to characterize the epidemiology of tuberculosis (TB) disease in Minnesota. The slides describe the demographic and clinical characteristics of TB statewide. The data in these slides pertain to confirmed cases of active TB disease reported from 2018 through 2022. In accordance with the Minnesota Communicable Disease Reporting Rule, physicians, laboratories, and other health care providers are required to report all probable and confirmed cases of TB disease among persons residing in Minnesota to the Minnesota Department of Health; such reports serve as the source of information for the data presented in these slides.

TB Morbidity and Mortality Minnesota, 2018-2022

as of September 29, 2023

Year	No. of New Cases (Rate)*	No. of TB Deaths (% of New Cases)**
2018	172 (3.1)	2 (1)
2019	148 (2.6)	7 (5)
2020	117 (2.1)	6 (5)
2021	134 (2.4)	11 (8)
2022	132 (2.3)	8 (6)

* Cases per 100,000 population. Rates calculated using state population estimates from the U.S. Census Bureau.

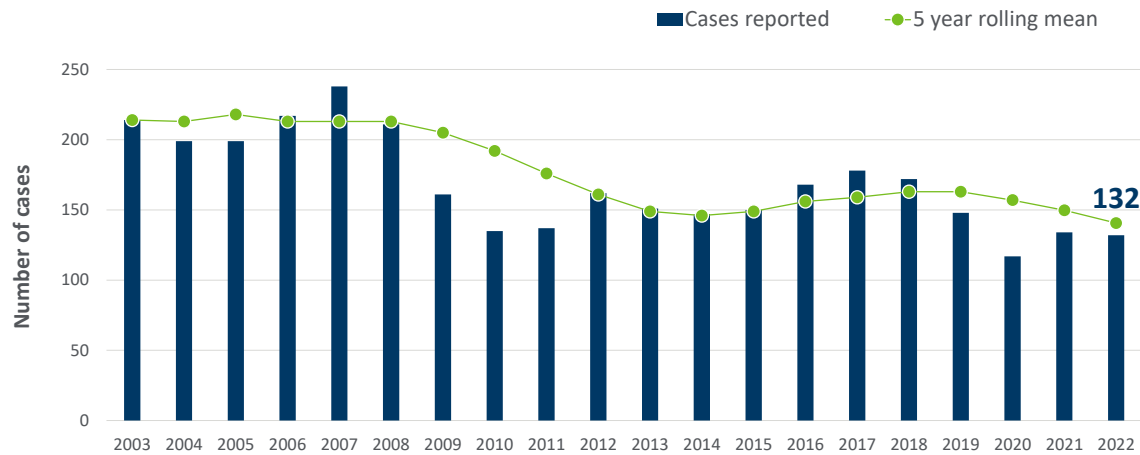
** Represents only deaths due to TB disease or TB drug-induced toxicity; percentages based on the number of new TB cases for each year

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In 2022, 132 new cases of active TB disease among persons in Minnesota were reported to the Minnesota Department of Health, similar to the number of new cases reported in 2021. This number corresponds to an incidence rate of 2.3 cases per 100,000 population. In comparison, 8,331 new cases of TB disease (2.5 cases per 100,000 population) were reported in the United States during 2022, an increase in case count of 5.9% from 2021. The median TB incidence rate among 52 states and reporting areas nationally was 1.7 cases per 100,000 population. Prior to 2020, national case counts and rates were decreasingly modestly (about 1-2% annually). A 20% decrease in case reports from 2019 to 2020 was due to a combination of factors: delayed diagnosis or misdiagnosis of TB from shifting resources in public health and underutilization of healthcare services, together with a true decrease in TB incidence from COVID-19 mitigation strategies during the pandemic. The increase in cases nationally from 2020 to 2021 and again from 2021 to 2022 reflects a return to pre-pandemic TB incidence.

This slide also depicts the number of deaths attributed to TB among new cases in Minnesota from 2018-2022. Overall, 5% of TB cases during this time period died as a result of TB, ranging from 1% of new cases in 2018 to 8% in 2021. One possibility for the relatively high case fatality rate among 2021 cases is higher burden of disease due to delayed diagnosis during the 2020 COVID-19 global pandemic response. These data do not include individuals who died from causes other than TB disease or TB drug-induced toxicity.

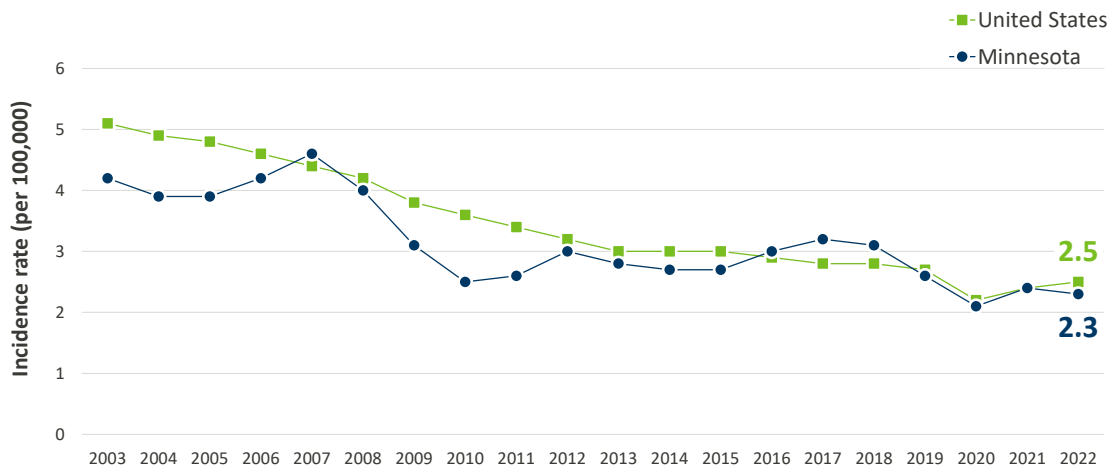
Active TB Cases Reported Annually Minnesota, 2003-2022



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Minnesota reported 132 TB cases in 2022 (1.6% of the 8,331 TB cases reported nationally in 2022). There was a recent upward trend from 2015-2017 followed by a decrease in 2018 that continues. However, the magnitude of the decrease seen between 2019 and 2020 may be artificially inflated due to missed diagnoses during the COVID-19 pandemic. Per CDC, “The causes of the decline and the long-term effect on progress toward TB elimination are under investigation but likely include a combination of factors associated with the COVID-19 pandemic, including TB underdiagnosis and a true decline in cases.”

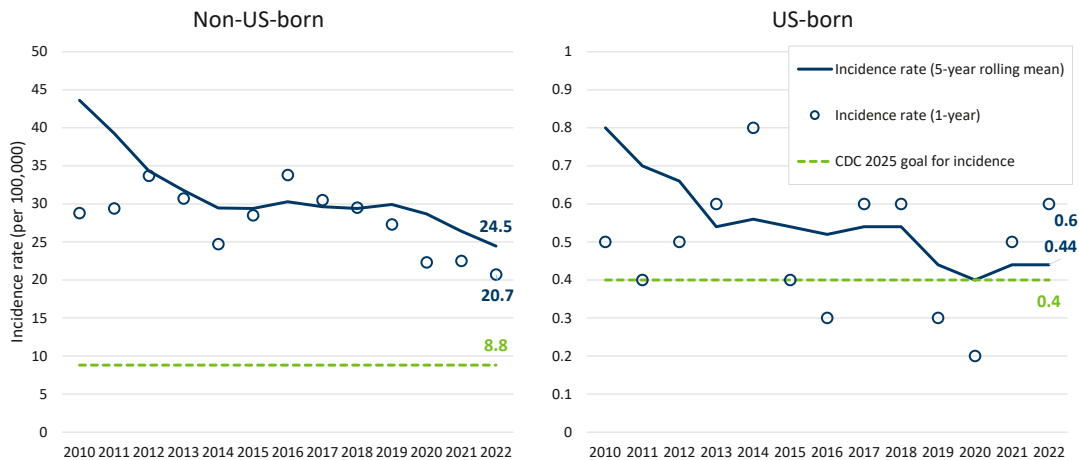
TB Incidence Rates per 100,000 Population United States and Minnesota, 2003-2022



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This slide depicts the annual incidence rate for TB in Minnesota and the United States from 2003 to 2022. From 2003-2022, the rate of TB in Minnesota was generally lower than the national rate (with the exceptions of 2007, and 2016-2018). In 2022, there were 2.3 new TB cases per 100,000 population in Minnesota and 2.5 per 100,000 population nationally. TB case counts and case rates in the US in 2020 were the lowest on record since national TB surveillance started in the 1950s. As mentioned in the previous slide, the decrease in 2020 case rate may be misrepresented due to the COVID-19 pandemic. The rates of TB in Minnesota and nationally have not met the Healthy People 2020 objective of 1.0 TB case per 100,000, nor the CDC 2025 objective of 1.3 per 100,000.

2025 CDC TB Incidence Reduction Targets for US-born and Non-US-born populations, Minnesota, 2010-2022

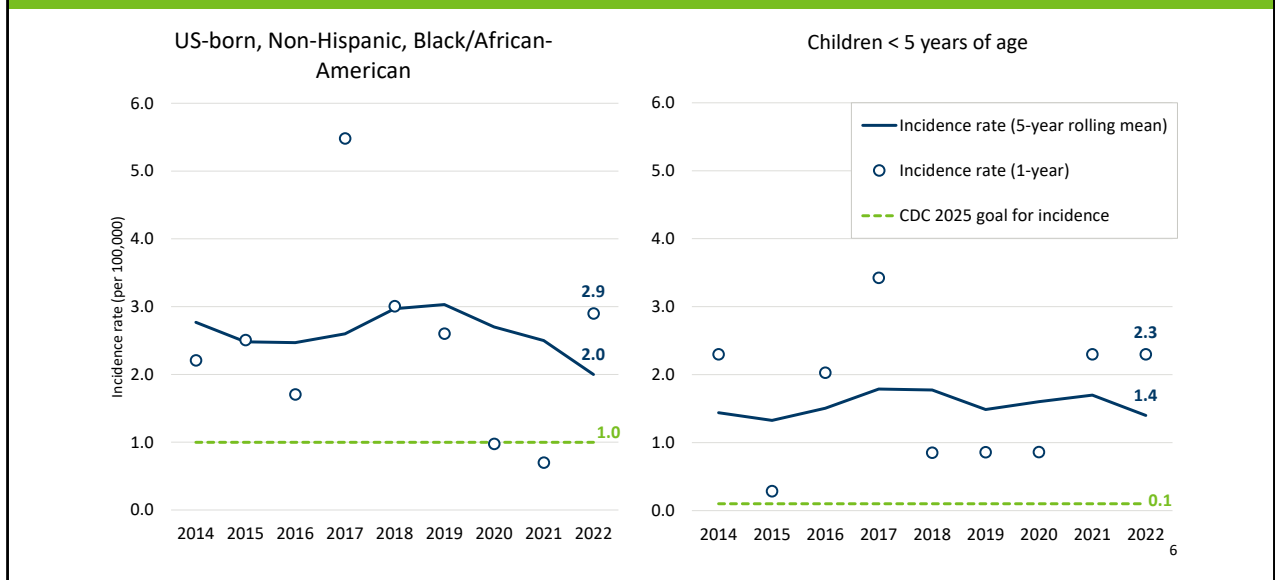


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While the overall state and national TB incidence rates are decreasing and relatively low compared to other countries, these aggregate rates do not represent the rates among different risk groups for TB. CDC has set a 2025 target TB incidence rate of 0.4 per 100,000 for the US-born population and 8.8 per 100,000 for the non-US born population. Minnesota has wavered closely above and below the target for the US-born population consistently for the past decade, with recent incidence rates below the 2025 target of 0.4 in 2019 and 2020. For Minnesota’s non-US-born population, the incidence rate has been decreasing overall since 2005 but has stayed above 20, well above the 8.8 target. Nationally, the TB incidence rate among non-US-born people has also been decreasing and has remained below 20 since 2009. Using 2018-2022 national and state population estimates, 37% of Minnesota’s non-US-born population was born in a WHO top 30 high burden country, while 26% of the overall non-US-born population within the US was born in a WHO top 30 high TB burden country*. This could explain some difference in the incidence rate of TB in the Minnesota’s non-US-born population compared to the national incidence rate for the non-US-born population. Increase in latent TB infection (LTBI) education and treatment for these communities and their healthcare providers would help reduce future TB incidence.

*Population data only available from 20 of 30 countries from 2022: ACS 5-Year Estimated Detailed Tables B05006 Place Of Birth For The Foreign-born Population In The United States.

2025 CDC TB Incidence Reduction Targets continued, Minnesota, 2014-2022

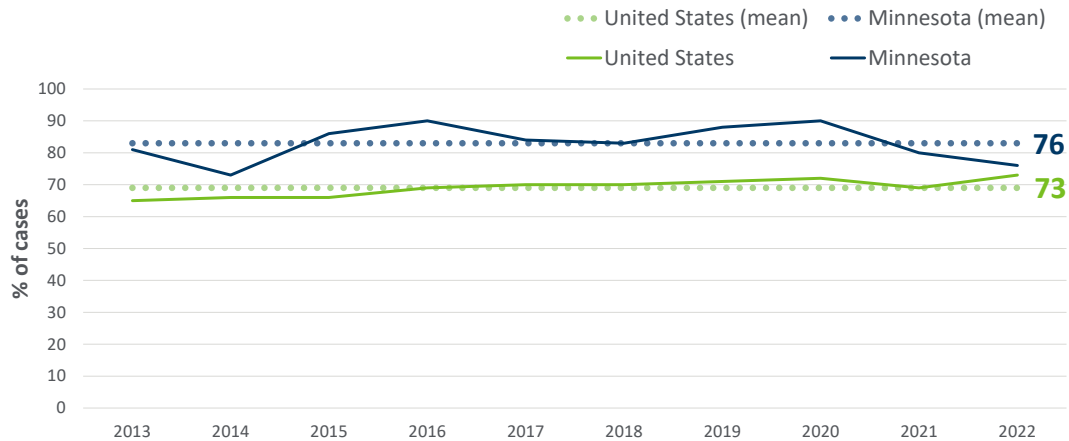


CDC has also set 2025 national incidence rate targets for the US-born, non-Hispanic, Black population and all children under 5 years of age, at 1.0 and 0.1 per 100,000 population, respectively. As indicated by the solid blue line in the first chart for US-born, Non-Hispanic, Black/African-American incidence rates, the 5-year rolling incidence rate for this population in Minnesota has remained around 2.5 per 100,000 (range 2.0 – 3.1 per 100,000). This is a better estimate of trends than the individual year-to-year incidence rates (depicted by the blue circles) due to small numbers. In the past 5 years (2018-2022), one-third of these US-born, non-Hispanic Black cases are pediatric cases (< 15 years old) with non-US-born parents. Reducing TB in the non-US-born population would decrease TB in this population, as well. Of the non-pediatric cases, 5% had a history of homelessness in the 12 months preceding diagnosis; 40% reported a history of substance use; and 15% had been in a correctional facility at some point during the 5 years leading up to their diagnosis. Connecting people to LTBI treatment and continued support for their treatment at treatment centers, homeless healthcare services, and correctional health services could help reduce TB in this population. 70% were assigned male at birth.

As seen in the chart on the right, the incidence rate among all children in Minnesota < 5 years old has averaged around 1.5 per 100,000 from 2014-2022 (range of 1.3 – 3.4 per 100,000). Again, the solid blue line provides a 5-year rolling average which gives a better sense of the trend due to small numbers. Ninety-six percent of these cases were non-US-

born or US-born with at least one non-US-born parent; 76% were found through active case finding (contact investigations or other targeted testing due to international travel); 8% reported international travel but were not screened upon return. TB screening after international travel is not requirement, but may be beneficial for reducing TB incidence in young children and people of all ages returning from visiting family and friends.

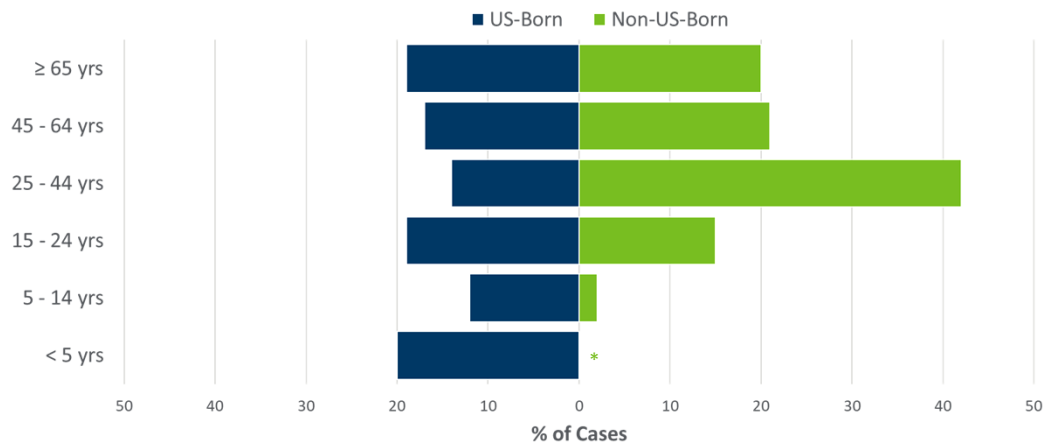
Proportion of TB Cases Born Outside of the United States United States and Minnesota, 2013-2022



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During the past ten years, the proportion of non-US-born persons among TB cases reported in Minnesota has averaged 83%, ranging from 73% in 2014 to 90% in 2016 and 2020. The average non-US-born percentage during this time period among cases reported nationally was 69% but has been increasing steadily. In 2022, 76% of TB cases in Minnesota were born outside the US, compared to 73% of TB cases reported nationally. The percentage of TB cases born outside of the US in Minnesota has consistently been higher than the national percentage. This was the first time the proportion of TB cases born outside of the US in Minnesota fell below 80% since 2014.

TB Cases by Age Group and Place of Birth Minnesota, 2018-2022



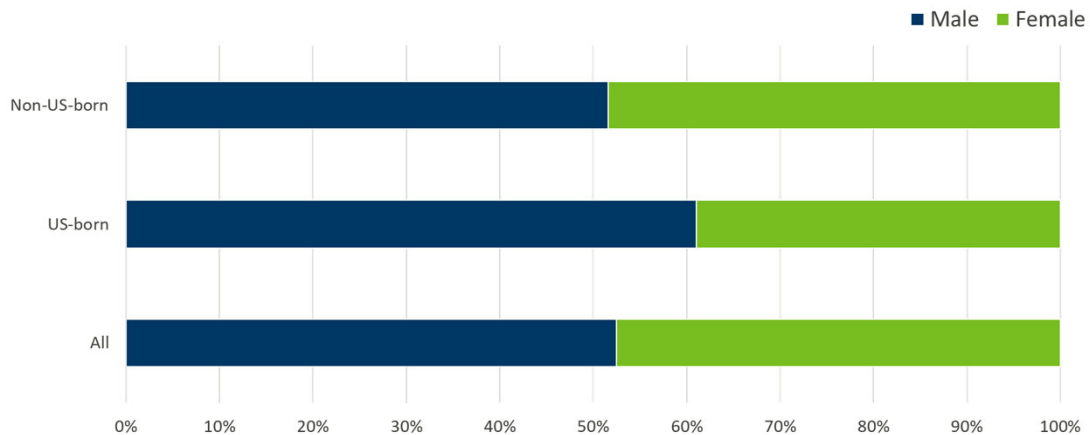
*1 non-US-born case < 5 years old

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The age distribution of TB cases reported in Minnesota differs markedly between US-born and non-US-born patients. The largest group (42%) of non-US-born TB cases reported in Minnesota from 2018 to 2022 was between 25 to 44 years of age, whereas the number of US-born cases was relatively more evenly distributed, with the highest number in the <5 year age group (20%). These strikingly different age distributions reflect the differing risks of exposure to TB among these populations. For example, newly-arrived refugees and immigrants to Minnesota tend to be younger adults, and TB cases in these age groups likely were already infected with TB before arriving in the US. Among US-born persons, adults who were born 60 or more years ago when TB was much more prevalent in Minnesota are more likely than younger US-born adults to have been infected with TB. As these older US-born persons age and develop other medical conditions that may weaken their immune systems, they may progress from latent TB infection to active TB disease.

The proportion of children under five years of age was much higher among US-born TB cases reported in Minnesota from 2018 through 2022 than among non-US-born cases (20% versus <1%, respectively). Ninety-six percent of these young US-born cases had at least one non-US-born parent or guardian and 75% were diagnosed with TB as a result of a contact investigation. These second-generation children appear to experience an increased risk of TB disease that more closely resembles that of non-US-born persons. These children were likely exposed to TB as a result of travel to their parents' country of origin or from family members or friends with active disease who are often primary caregivers.

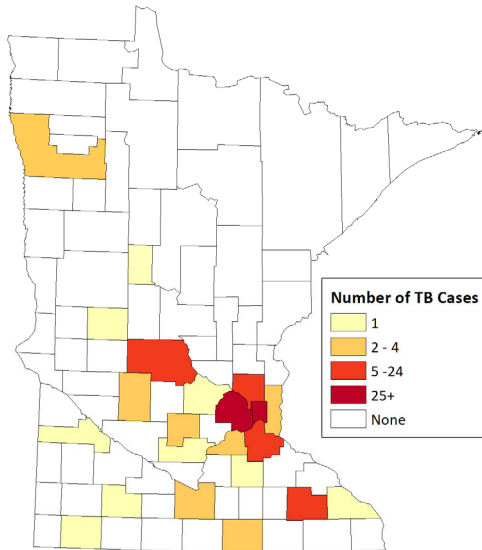
TB Cases by Sex Assigned at Birth and Place of Birth Minnesota, 2018-2022



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This slide presents data on TB cases, by sex assigned at birth, reported in Minnesota from 2018 through 2022. More males than females were represented among TB cases reported statewide (52% to 48%), which is typical of TB cases reported in the United States. Among the US-born TB cases, the difference in sex assigned at birth was a little wider (61% males to 39% females). Among non-US-born TB cases, the distribution of sex assigned at birth was closer to the statewide percentages (52% males to 48% females). The difference in TB rates by sex assigned at birth and birthplace could be due to the unequal distribution of TB risk factors among US-born cases, such as persons experiencing homelessness and history of military service.

TB Disease by County of Residence Minnesota, 2022



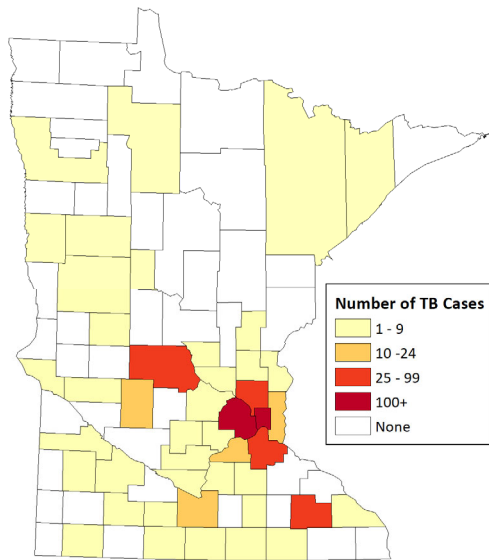
Location of Residence	Count (% of total)
Hennepin County	44 (33)
Ramsey County	28 (21)
Suburban Metro*	28 (21)
Greater MN	32 (25)
Total	132

*Anoka, Carver, Dakota, Scott, Washington

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This slide presents a map of Minnesota with counties shaded according to the number of TB cases reported in their jurisdictions during 2022. Although 22 (25%) of the state's 87 counties reported at least one new case of TB disease in 2022, the majority of cases (75%) occurred in the Twin Cities seven-county metropolitan area. This aligns with the population distribution of those most at risk for tuberculosis: Minnesota's non-US-born population (78% reside in the seven-county metro; 21% reside in Greater MN).

TB Disease by County of Residence Minnesota, 2018-2022



Location of Residence	Count (% of total)
Hennepin County	227 (32)
Ramsey County	162 (23)
Suburban Metro*	137 (19)
Greater MN	177 (25)
Total	703

*Anoka, Carver, Dakota, Scott, Washington

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This slide presents data on TB cases, by county of residence, reported in Minnesota from 2018 through 2022. Similar to the previous slide, these data emphasize that the greatest burden of TB disease occurred primarily in certain areas of the state, although the geographic distribution of cases was more widespread. Of the state's 87 counties, 45 (52%) reported at least one case of TB disease during this five-year period. Hennepin and Ramsey counties accounted for 55% of all new TB cases reported during this time period, the metro as a whole reported 75% of cases, and 25% of cases were reported in Greater Minnesota. Minnesota's non-US-born population (78% reside in the seven-county metro; 21% reside in Greater MN).

Number of Cases and Incidence of TB by Location of Residence Minnesota, 2018-2022

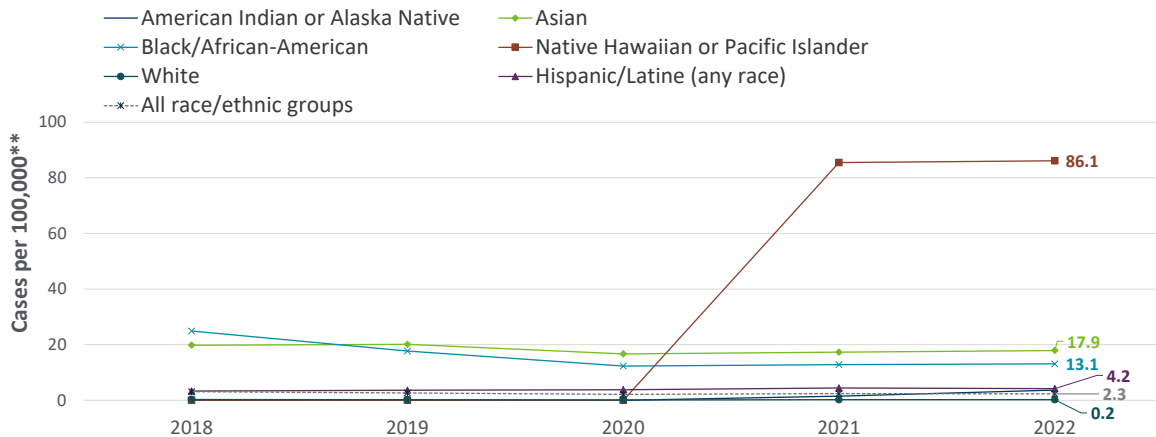
Location of Residence	2018 No. (Rate)*	2019 No. (Rate)*	2020 No. (Rate)*	2021 No. (Rate)*	2022 No. (Rate)*
Hennepin County	54 (4.3)	53 (4.2)	44 (3.5)	32 (2.5)	44 (3.5)
Ramsey County	34 (6.2)	29 (5.3)	31 (5.6)	40 (7.3)	28 (5.1)
Suburban Twin Cities Metro†	33 (2.6)	26 (2.0)	20 (1.5)	30 (2.3)	28 (2.1)
Olmsted County	12 (7.7)	6 (3.8)	1 (0.6)	4 (2.5)	5 (3.1)
Greater Minnesota (excluding Olmsted)	39 (1.7)	34 (1.4)	21 (0.9)	28 (1.2)	27 (1.1)
Total	172 (3.1)	148 (2.6)	117 (2.1)	134 (2.4)	132 (2.3)

* Cases per 100,000 population. Rates calculated using state population estimates from the U.S. Census Bureau.
† Anoka, Carver, Dakota, Scott, and Washington counties

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This slide presents the number and rate of new TB cases reported by county of residence in Minnesota from 2018 through 2022. County-specific data are presented for Hennepin, Ramsey, and Olmsted counties, which are the three counties in Minnesota that operate public TB clinics. The slide also presents data for the five-county suburban Twin Cities metropolitan area and for Greater Minnesota, excluding Olmsted County. Among the seven-county metro area counties, the highest TB incidence rate in 2022 was reported in Ramsey County (5.1 cases per 100,000 population).

TB Incidence Rate by Race*/Ethnicity Minnesota, 2018-2022



*Race categories do not include persons of Hispanic/Latino ethnicity. 1 multi-racial case is not included.

**Rate per 100,000 population. Calculated using population estimates from the U.S. Census Bureau.

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This slide depicts the incidence rate of TB disease by race/ethnicity in Minnesota from 2018 through 2022. Native Hawaiian or Pacific Islander data has now been disaggregated from Asian data, where they were combined in previous releases of this slide set. Non-white racial and ethnic populations in Minnesota are disproportionately affected by TB. In particular, the incidence rate of TB disease reported in 2022 was significantly higher among Native Hawaiians and other Pacific Islanders (86.1) than any other racial or ethnic group. This is the smallest community in Minnesota with < 2,500 population, largely resettling from the Federated States of Micronesia through a special Compact of Free Association (COFA). The incidence rate of TB disease reported in 2022 remains high among Asians (17.9 cases per 100,000 population), followed closely by Black/African-Americans (13.1 cases per 100,000 population), a group that has seen a significant decrease in TB incidence since 2018. In comparison, the TB case rate among non-Hispanic whites was 0.2 cases per 100,000 population. The TB incidence rates among Hispanics/Latinos in 2022 was 4.2 cases per 100,000 population and American Indian or Alaska Natives was 2.3 per 100,000. During this five-year period, TB rates were generally highest among Black/African-Americans, Asians, and Native Hawaiians or Pacific Islanders.

TB Cases by Race/Ethnicity and Place of Birth Minnesota, 2018-2022

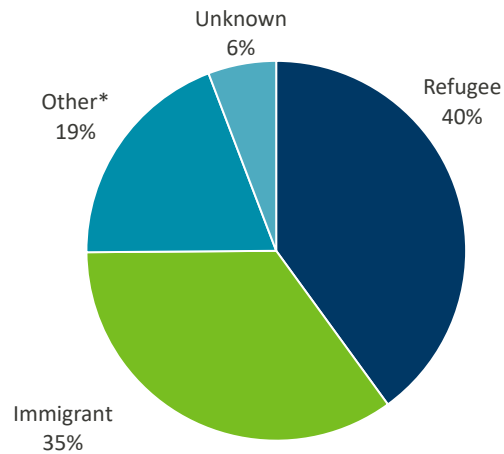
Race* / Ethnicity	Non-US-Born Cases No. (%)	US-Born Cases No. (%)
White	9 (2)	40 (34)
Black/African-American	298 (51)	31 (26)
Asian	225 (38)	30 (25)
American Indian / Alaska Native	0	4 (3)
Native Hawaiian / Pacific Islander	3 (<1)	1 (1)
Multi-racial	0	1 (1)
Hispanic / Latine	50 (9)	11 (9)
Total	585 (100)	118 (100)
*Race categories do not include persons of Hispanic/Latine ethnicity		

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The racial and ethnic distribution of TB cases reported in Minnesota from 2018 through 2022 differed between non-US-born and US-born populations. Among non-US-born cases, the majority (51%) were Black, 38% were Asian, 9% were Hispanic or Latine, 2% were white, and three cases were Native Hawaiian or Pacific Islander (<1%). Among the much smaller number of US-born TB cases, the largest proportion (34%) were white, 26% were Black, 25% were Asian, 9% were Hispanic or Latine, 3% were American Indian or Alaska Native, one case reported as Native Hawaiian or Pacific Islander, and one case reported as multi-racial.

Non-US-Born TB Cases by Visa Status Upon Arrival in the US Minnesota, 2018-2022

N = 585



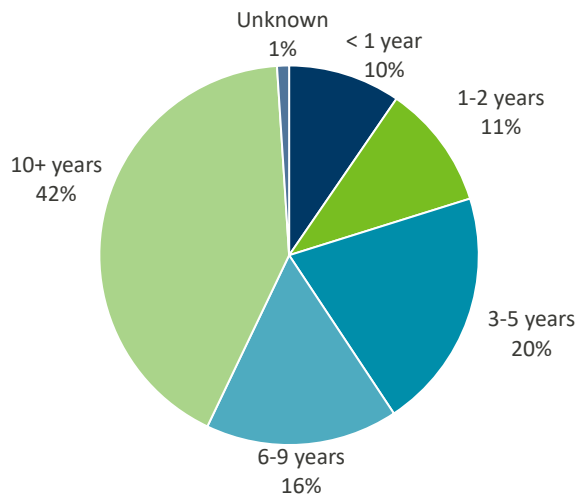
* "Other" includes visitors, tourists, students, and those arriving on employment visas

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Persons arriving as refugees or immigrants seeking permanent residence in the United States are screened prior to immigration for conditions of public health significance, including communicable diseases such as pulmonary TB disease. It is also recommended that all refugees be screened again within three months of their arrival in the US. Forty percent of the non-US-born TB cases reported in Minnesota from 2018 through 2022 initially arrived to the US as refugees, and another 35% arrived as immigrants. Nineteen percent of non-US-born TB cases arrived with other non-immigrant visa classifications, including visitors, tourists, students, and those with employment visas; TB screening prior to or after US arrival is not required for these persons although individual institutions may decide to screen international students and employees. Visa status upon arrival was unknown for 6% of non-US-born TB cases.

Non-US-Born TB Cases by Interval Between Arrival in US and Diagnosis of TB Minnesota, 2018-2022

N = 585



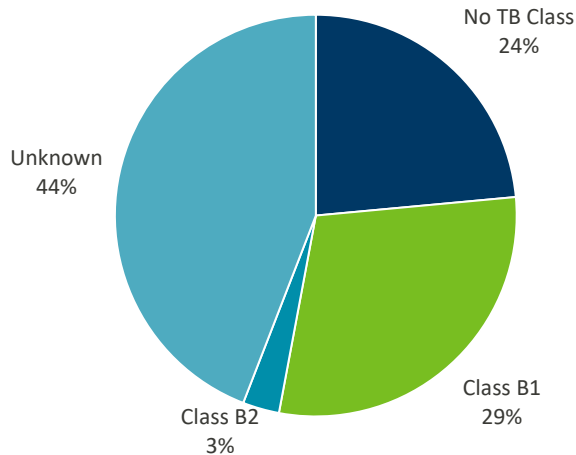
16

Ten percent of non-US-born TB cases reported in Minnesota from 2018 to 2022 had resided in the United States for less than one year when they were diagnosed with TB disease. These patients most likely acquired latent TB infection outside the US and began progressing to active TB disease just prior to or soon after arriving in the US. Although many such cases may not be preventable in the US, there is additional TB screening required for a number of new arrivals to promptly diagnose active disease and initiate treatment. 2020 and 2021 saw a dramatic decrease in the proportion of non-US-born TB cases diagnosed within one year of arrival to the US (4% and 5%, respectively), likely due to entry restrictions during the COVID-19 pandemic response.

Most of the non-US-born TB patients developed active disease after living in the US for a number of years. Over half of non-US-born TB cases reported in Minnesota from 2018-2022 had been in the US for six years or longer prior to being diagnosed with TB disease, the largest group (42%) developing active disease at least 10 years after arrival. Many of these patients reported advanced age and co-morbidities increasing the likelihood of progressing to active TB disease. These data show the importance of thorough domestic screening of recent arrivals as well as evaluation and treatment of latent TB infection among older populations with co-morbidities.

TB Class Notifications* Among Refugees/Immigrants Diagnosed with TB within One Year After Arrival to US Minnesota, 2018-2022

N = 34



* Per results of pre-immigration screening performed overseas

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As mentioned in a previous slide, immigrants and refugees undergo medical evaluation, including TB screening, prior to coming to the United States. Individuals with TB-related conditions identified overseas are assigned a TB Class designation: Class A, which indicates active and potentially infectious TB disease; Class B0 indicates on TB treatment and verified as successfully completing therapy prior to departure; Class B1 indicates signs or symptoms or findings suggestive of TB disease, but has negative sputum smears and cultures prior to travel, meaning not infectious during travel but needs prompt evaluation after arrival; Class B2 indicates latent TB infection; and Class B3 indicates being a recent contact with infectious TB. For immigrants and refugees with a TB Class condition, the US Centers for Disease Control and Prevention (CDC) notifies the state public health department where the patient is expected to arrive. State and local public health professionals in Minnesota collaborate to ensure that these individuals are referred to a local health care provider for comprehensive TB evaluation and treatment, as indicated.

Among new refugees and immigrants who were diagnosed with TB disease in Minnesota from 2018 to 2022 within one year after their arrival in the US, only 32% had a known TB Class designation assigned overseas while 24% had documented overseas screening results showing no indication of a TB Class condition. The results of the overseas medical evaluations were unknown for 44% of these non-US-born TB cases. These patients included persons who initially resettled in another US state and whose overseas screening results were not available to the Minnesota Department of Health. These findings strongly suggest that clinicians cannot rely solely on the results of pre-immigration medical examinations performed overseas to identify TB disease among non-US-born persons. Clinicians should have a high index of suspicion for TB in any non-US-born patient from TB endemic areas who presents with signs or symptoms consistent with active TB disease.

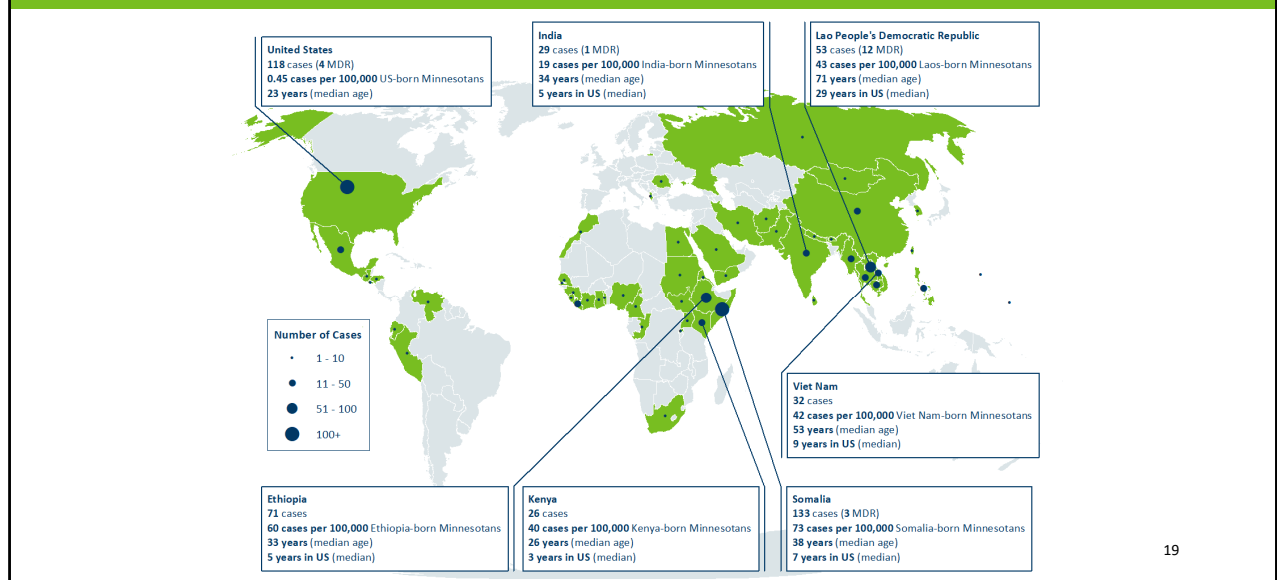
Non-US-Born TB Cases by Top Five Countries of Birth Minnesota, 2018-2022

Country of Birth	No. of Cases (%)
Somalia	133 (23)
Ethiopia	71 (12)
Laos	53 (9)
Viet Nam*	32 (5)
India*	29 (5)
Kenya	29 (5)
Other	238 (41)
Total	585
* Top 5 nationally in 2022. In order, these countries are Mexico, Philippines, India, Viet Nam, China.	

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From 2018 to 2022, 83% (585) of TB cases in Minnesota were born outside the United States and 17% (118) were US-born. Among the non-US-born TB cases reported in Minnesota during this five-year time period, the largest percentage (23%) were born in Somalia. Other countries of birth representing the top five were Ethiopia (12%), Laos (9%), Viet Nam, India, and Kenya (5% each). Patients from a geographically and ethnically diverse group of 53 other countries comprised the remaining 41% of non-US-born TB cases reported during this period. This diversity among non-US-born TB cases in Minnesota poses challenges for those providing TB treatment, and prevention and control services that are appropriate for persons from such a wide array of cultural, linguistic, and socioeconomic backgrounds. However, country of birth cannot be the only piece of demographic information to inform culturally and linguistically appropriate services. For example, 87% of the Laos-born TB cases during this time period identified as Hmong, not Laotian. Conversely, 15% of TB cases that needed Somali language services were born outside of Somalia.

Number of TB Cases by Country of Birth Minnesota, 2018-2022



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This map shows the number of TB cases in Minnesota from 2018-2022 by country of birth. Details are provided for the top five countries of birth and the United States. Case rates were calculated using 2022 5-year ACS data for place of birth of people in Minnesota. As noted in the previous slide, non-US-born TB cases are diverse. People from around the world have arrived in Minnesota for a variety of reasons at different points throughout history. For example, TB cases from Lao People's Democratic Republic are primarily Hmong elders, resettled in the US as refugees in waves in the 1980s and mid-2000s. TB cases from Somalia have arrived as refugees or with an immigrant visa due to civil war and political unrest in the 1990s. The relatively young median age of cases born in Somalia and their migration reasons suggest this will be a population to monitor for future TB as the population ages. By contrast, three-quarters of the cases born in India arrived in Minnesota with student, employment, and tourist/visitor visas and may not be here long-term. The birth places of TB patients have varying rates of TB, from low-incidence countries like the United States to high incidence countries where TB is endemic.

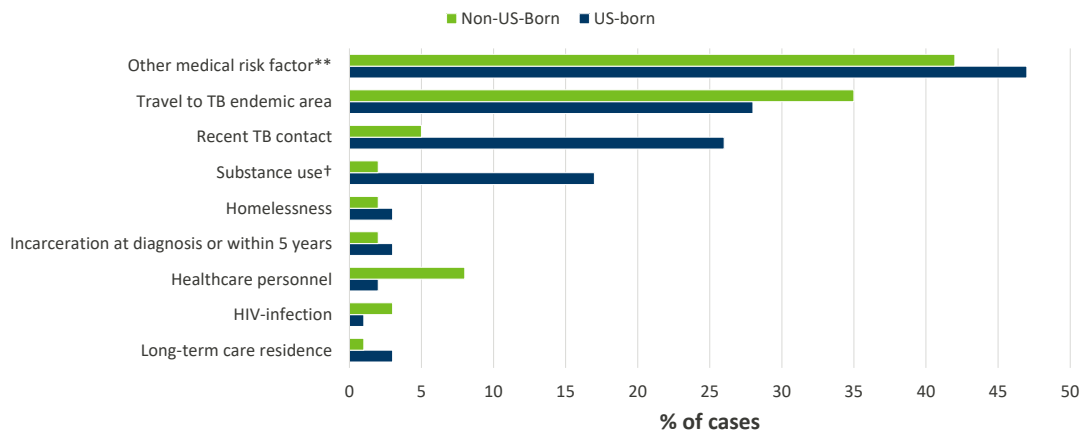
TB Cases by Method of Case Identification Minnesota, 2018-2022

Method of Identification	No. of Cases (%)
TB symptoms	580 (83)
TB contact investigations	48 (7)
Overseas TB Class follow-up	7 (1)
Domestic refugee health exam	5 (<1)
Other immigration exams	6 (<1)
Employment screening (including health care personnel)	14 (2)
Other targeted testing	16 (2)
Incidental imaging or lab result	27 (4)
Total	703

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While the vast majority (83%) of TB cases reported in Minnesota from 2018 through 2022 were identified only after presenting at clinics or hospitals with symptoms of TB disease, a number of cases were identified from TB screening or other active case finding methods. Seven percent of TB cases were found as a result of contact investigations conducted by local health departments surrounding individuals with infectious TB. About three percent of cases were identified through refugee and immigration related exams. Two percent of cases were identified through other targeted testing, including TB screening of international students in colleges or overseas adoptees. Screening for employment purposes identified 2% of cases (50% of these were healthcare worker screening). The remaining four percent of TB cases reported during this time period were identified as a result of laboratory or radiologic tests performed for reasons other than suspected TB disease.

TB Cases by Risk Category* and Place of Birth Minnesota, 2018-2022



*Risk categories are not mutually exclusive

**Conditions or therapies increasing risk for progression to active TB disease, not including HIV/AIDS

†Excess alcohol use and/or injection or non-injection drug use

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The distribution of risk factors for TB infection and progression to active disease differs greatly by place of birth. Note that a patient can have multiple TB risk factors. Among TB cases reported in Minnesota from 2018 to 2022, patients born in the US were more likely to have been a contact to an infectious TB patient within the past two years, a history of substance use, experienced homelessness within the year prior to TB diagnosis, been incarcerated within the last five years or at time of diagnosis, and resided in a long-term care facility at the time of diagnosis. Non-US-born cases, on the other hand, were more likely to have traveled to a TB endemic area, be co-infected with HIV, and more likely to have worked in a healthcare setting in the year preceding their diagnosis. Only 22% of all healthcare personnel TB cases were identified through healthcare personnel screening. No cases among healthcare personnel were attributed to occupational exposure.

TB patients born in the US were more likely to report having a medical risk factor for progression to active TB disease (excluding HIV/AIDS): 47% of US-born TB cases compared to 42% of non-US-born cases. Among US-born cases reporting a comorbid condition, the two most commonly reported medical risk factors were immunosuppressive conditions (not HIV/AIDS) or therapy (23%) and diabetes (16%). Among non-US-born patients, the most commonly reported medical condition was diabetes (48%), followed by immunosuppressive conditions (not HIV/AIDS) or therapy (17%).

31% of all cases had none of the TB risk factors described above (34% of all non-US-born

cases and 10% of all US-born cases).

TB Cases With Other Medical Risk Factors* by Type of Risk Factor Minnesota, 2018-2022

Medical risk factor**	Cases (N=703) No. (%)
Diabetes	127 (18)
Immunosuppressive condition (not HIV/AIDS) or therapy***	55 (8)
End stage renal disease	18 (3)
Weight loss/undernutrition/malabsorption	18 (3)
Other (e.g. chronic kidney disease, active smoking, hematologic disease, COVID-19)	171 (24)

* Conditions or therapies that increase risk for progression from latent TB infection to active TB disease, not including HIV/AIDS

** Patients could have > 1 medical condition

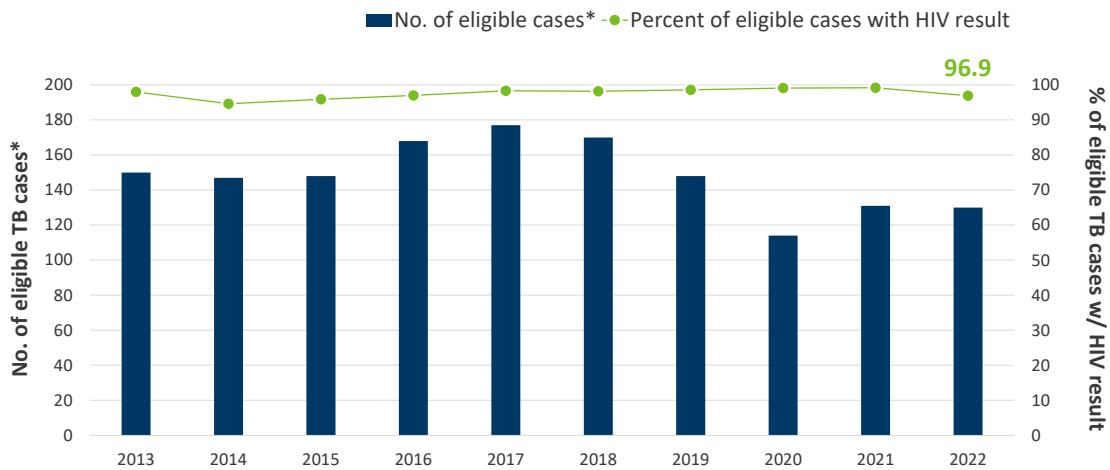
*** Includes TNF α antagonist therapy and post-organ transplant anti-rejection drugs

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As mentioned in the previous slide, certain medical risk factors, in addition to HIV/AIDS, increase the likelihood that latent TB infection will progress to active TB disease. The most commonly reported condition was diabetes, accounting for 18% of all TB cases reported in Minnesota during 2018-2022. Nearly a quarter reported other factors increasing the risk of TB disease progression, including chronic kidney disease, active smoking, and hematologic disease. Eight percent reported having an immunosuppressive condition (not including HIV/AIDS) or were on immunosuppressive therapy at the time of the TB diagnosis.

Smaller proportions of TB cases reported other conditions: end stage renal disease (3%) and significant weight loss (not as a result of TB disease) or undernutrition (3%). This slide illustrates that screening for tuberculosis (and treatment for latent TB infection, if indicated) should be routinely considered for individuals with these medical conditions. Almost a quarter of the patients reported other medical risk factors such as active smoking, chronic kidney disease, or COVID-19 infection within one year before or after being reported as a possible case of TB.

HIV Testing in Persons with TB Minnesota, 2013-2022



*Alive at time of diagnosis

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It is critical that all TB patients with an unknown HIV status be screened for HIV, since the TB treatment regimen for co-infected individuals is more complex. Since a change made in HIV screening recommendations for TB patients in 2010, the percentage of Minnesota TB cases with a known HIV status has consistently been high, on average 98%. Conversely, it is also important that HIV-infected patients be screened for LTBI, as these individuals are a high priority group for LTBI treatment.

TB Cases by HIV Status and Place of Birth Minnesota, 2018-2022

HIV Status	Non-US-Born Cases No. (%)	US-Born Cases No. (%)	Total No. (%)
Negative	557 (95)	113 (96)	670 (95)
Positive	15 (3)	1 (<1)	16 (2)
Not Offered	9 (2)	2 (2)	11 (2)
Refused HIV testing	4 (<1)	1 (<1)	3 (<1)
Unknown	0	1 (<1)	1 (<1)
Total	585	118	703

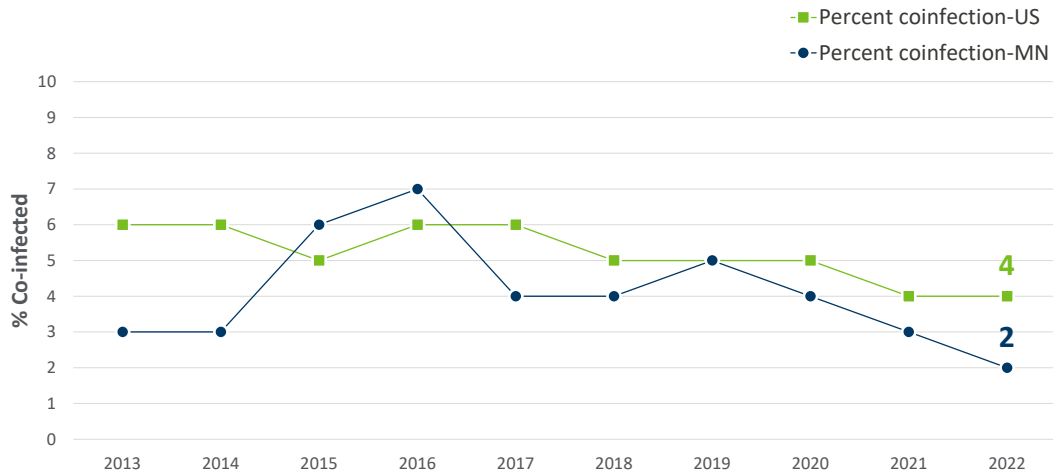
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Co-infection with HIV is the most significant medical risk factor for progression from latent TB infection to active TB disease. It is estimated that individuals infected with both TB and HIV have up to a 10% annual risk of developing active TB disease, compared to a 5-10% lifetime risk for those with latent TB infection in general. For this reason, TB diagnostic and treatment guidelines recommend that patients with active TB disease receive HIV testing at the time of diagnosis, unless they are already known to be HIV-positive.

This slide presents TB cases reported in Minnesota from 2018 through 2022 by HIV status and place of birth. During this time period, HIV status was known for 97% of TB cases in Minnesota. Two percent tested positive for HIV. The prevalence of HIV co-infection among non-US-born TB cases was greater than that of US-born TB cases (3% versus <1%, respectively).

Eleven of the 15 cases without a known HIV status were not offered the test by their provider. It is recommended for all TB cases, regardless of their place of birth. The single US-born TB case with unknown HIV status was diagnosed with TB during autopsy.

TB-HIV Co-infected Cases United States and Minnesota, 2013-2022

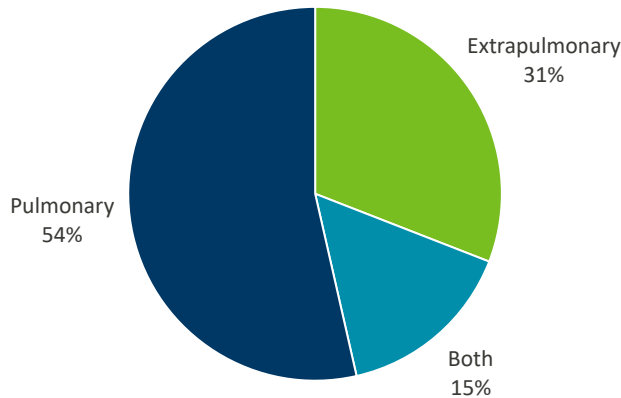


25

The TB-HIV co-infection rate has generally been lower in Minnesota than in the United States over the past decade, with the exception of 2015, 2016, and 2019. On average, 4% of all Minnesota TB cases in the past decade were co-infected with HIV. In comparison, an average of 5% of all TB cases in the U.S. since 2013 were also infected with HIV, and this rate has been decreasing.

TB Cases by Site of Disease Minnesota, 2018-2022

N = 702



Top five extrapulmonary sites of disease*	Cases (N=326)**
	No. (%)
Lymphatic	153 (47)
Musculoskeletal	57 (17)
Pleural	45 (14)
Peritoneal	36 (11)
Genitourinary	23 (7)

* Patients may have multiple extrapulmonary sites of disease

** Includes TB cases with and without concurrent pulmonary disease

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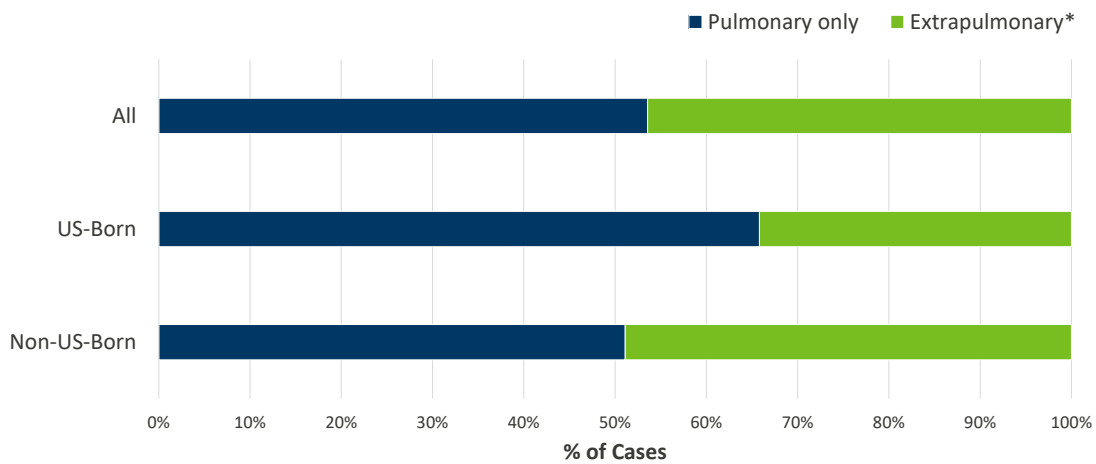
Tuberculosis disease most commonly affects the lungs, although it can affect almost any site in the body. Over half (54%) of the cases reported from 2018 to 2022 had TB disease exclusively in the lungs, and another 15% had TB in both pulmonary and extrapulmonary sites. TB was found exclusively in extrapulmonary sites in 31% of cases.

Among extrapulmonary TB cases reported in Minnesota from 2018 through 2022, almost half (47%) had lymphatic disease. The musculoskeletal system (includes the bone/joint and any surrounding muscles or tissues) was the second most common site, accounting for 17% of extrapulmonary cases. The next three most common sites were pleural, peritoneal, and genitourinary sites, affecting 14%, 11%, and 7% of extrapulmonary TB cases, respectively. Note that a person can have more than one extrapulmonary site of disease.

A quarter of TB patients from 2018-2022 had a more unique site of disease, including, but not limited to, eye and eye appendages, brain, small intestine, liver, and blood.

One case did not have a site of disease stated. This case was a newborn with TB acquired in utero.

TB Cases by Site of Disease and Place of Birth Minnesota, 2018-2022



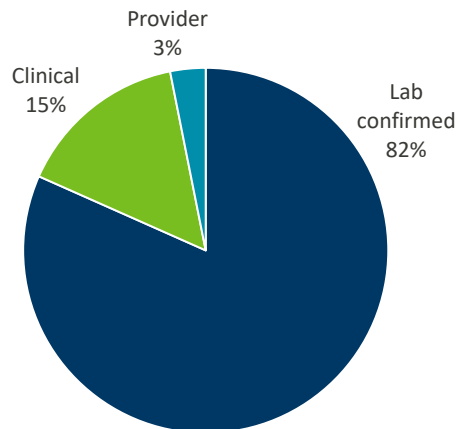
* Includes cases with and without concurrent pulmonary disease

27

Extrapulmonary TB is diagnosed more frequently among non-US-born TB cases than among US-born TB cases. Just over half of non-US-born TB cases reported in Minnesota from 2018 through 2022 had an extrapulmonary site of disease, as compared to one-third of US-born cases. This slide illustrates the need for clinicians to have a high index of suspicion for TB particularly for non-US-born patients, even when the patient does not present with a cough or abnormal chest radiograph or other common signs and symptoms of pulmonary TB.

TB Cases by Case Verification Criteria* Minnesota, 2018-2022

N = 703



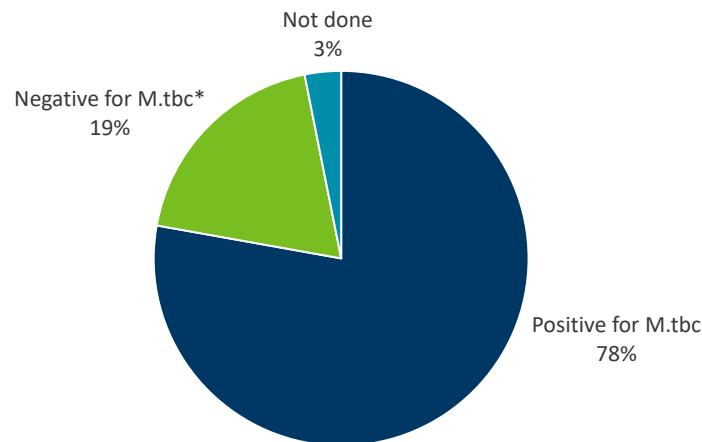
*Based on the public health surveillance definition for TB [CDC. (August 2021) CDC Tuberculosis Surveillance Data Training: 2020 Report of Verified Case of Tuberculosis (RVCT) Instruction Manual. Atlanta, GA: U.S. Department of Health and Human Services, CDC. (Appendix A - Tuberculosis Case Definition for Public Health Surveillance)]

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This slide shows the proportions of TB cases reported in Minnesota from 2018 through 2022 who met the various hierarchical levels of the national surveillance case definition for reportable TB disease. Over 80% of Minnesota's TB cases were laboratory-confirmed: counted on the basis of a culture that was positive for *Mycobacterium tuberculosis* complex, or less commonly, a positive nucleic acid amplification test for TB, or demonstration of acid-fast bacilli when cultures could not be done. Lab tests were either negative for *M. tuberculosis* complex or not done in the remaining 18% of cases. Most of those patients (15% of all cases) met the clinical component of the national TB case definition: they had a positive tuberculin skin test (TST) or positive interferon gamma release assay (IGRA, or TB blood test), but no laboratory confirmation of active TB bacteria. Clinical cases also must have signs or symptoms of TB and be on anti-TB treatment. Very few (3%) cases met neither the laboratory nor the clinical case criteria and, therefore, were counted solely on the basis of a provider diagnosis.

TB Cases by Mycobacterial Culture Result Minnesota, 2018-2022

N = 703



*No growth or growth of other Mycobacterium species not part of *M.tb* complex

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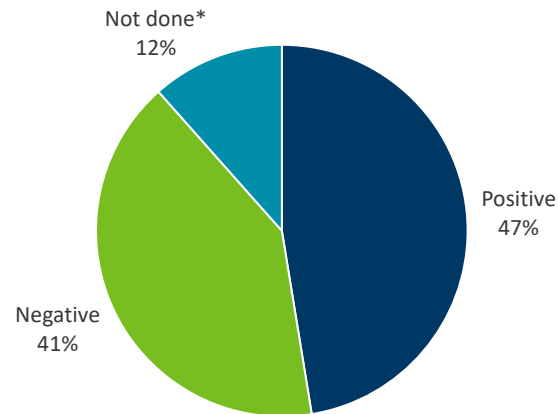
Identification of *Mycobacterium tuberculosis* (or related species known to cause active TB disease, collectively called the *M. tuberculosis* complex) grown in culture from a clinical specimen is the “gold standard” for definitive diagnosis of TB disease, although the national surveillance case definition also allows cases to be counted on the basis of other criteria, as seen in the previous slide. Culture confirmation of TB disease is critically important for the clinical management of TB cases, because most drug susceptibility testing is performed on isolates grown in culture. Also, for pulmonary TB cases, documentation of the conversion of an initially positive sputum culture to a negative culture is an important marker of successful response to TB treatment.

Genetic sequencing is routinely performed on isolates to support or rule out related clusters of cases, which helps prioritize interventions to prevent ongoing transmission.

Seventy-eight percent of TB cases reported in Minnesota from 2018 through 2022 were confirmed by the identification of *M. tuberculosis* complex from culture, while 19% had negative culture results. Initial mycobacterial culture was not performed or results were not reported for 3% of cases.

TB Cases with Pulmonary Involvement by Initial Sputum AFB Smear Result Minnesota, 2018-2022

N = 485



**50% of pulmonary cases without sputum smear results were under 15 years of age*

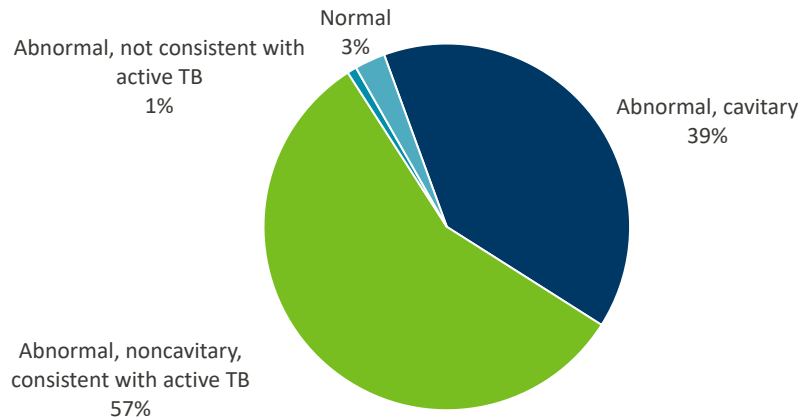
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Persons with TB in the lungs or larynx may be infectious or able to transmit TB to others. The detection of acid-fast bacilli (AFB) in smears of sputum specimens obtained from a patient with pulmonary or laryngeal TB disease is one indicator of the patient's level of infectiousness. Patients with positive AFB smears from sputum are considered potentially infectious. Although transmission of TB bacteria from sputum AFB smear-negative patients has been documented, such patients are considered less infectious than sputum AFB smear-positive patients..

Among 485 patients with pulmonary TB disease reported in Minnesota from 2018 through 2022, 47% had at least one initial sputum specimen with an AFB-positive smear result, and thus potentially able to spread TB to others prior to receiving several weeks of adequate treatment for TB disease. Twelve percent had no initial sputum smear result reported. Half of the pulmonary patients without sputum smear results were children under the age of 15 years; this reflects the difficulty in obtaining sputum specimens for laboratory confirmation in many pediatric cases. Gastric aspirates are usually recommended for young children.

TB Cases with Pulmonary Involvement by Chest Imaging* Result Minnesota, 2018-2022

N = 485



* From initial chest x-ray or chest CT scan. Two cases with pulmonary involvement did not have chest imaging performed (1 diagnosis made post-mortem).

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A posterior-anterior radiograph of the chest is one of the primary diagnostic tests performed to detect abnormalities suggestive of active pulmonary TB disease. In pulmonary TB, chest x-ray abnormalities often are seen in the apical and posterior upper lobes of the lungs or in the superior segments of the lower lobes. Cavitary lesions are indicative of severe or advanced disease and increase the likelihood of infectiousness in TB patients.

Among 485 pulmonary TB cases with chest imaging reported in Minnesota from 2018 through 2022, the vast majority (96%) had findings from chest imaging (chest x-ray or chest CT scan) consistent with TB disease, including 191 (39%) patients with cavitary lesions. Three percent of pulmonary TB cases had chest imaging results that were normal or not consistent with TB disease. Two cases did not have any chest imaging performed.

TB Cases by Drug Susceptibility Patterns and Year Minnesota, 2018-2022

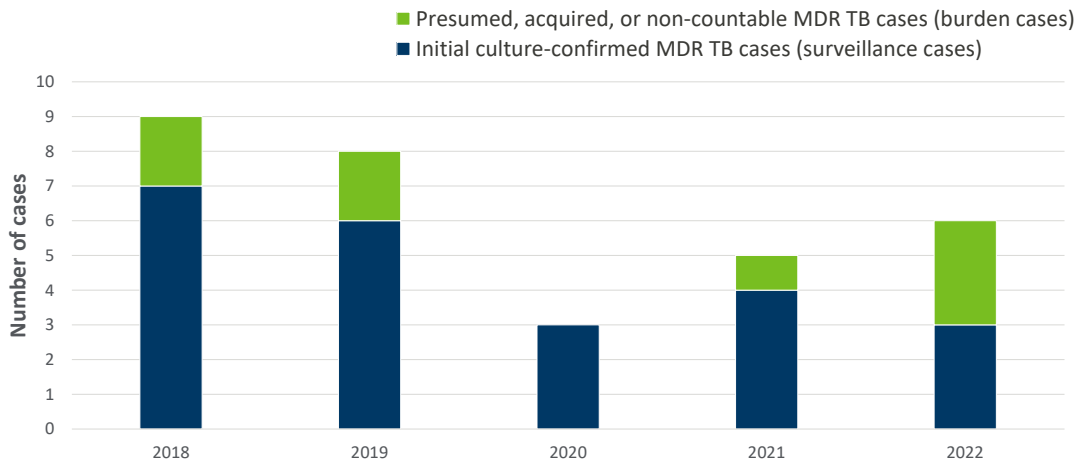
Year	Cases With Susceptibility Results*	Any Drug Resistance† No. (%)	INH-Resistant** No. (%)	MDR TB‡ No. (%)
2018	134	26 (19)	16 (12)	7 (5)
2019	126	17 (13)	13 (10)	6 (5)
2020	90	12 (13)	11 (12)	3 (3)
2021	94	10 (11)	9 (10)	4 (4)
2022	103	13 (13)	11 (11)	3 (3)
Total	547	78 (14)	60 (11)	23 (4)

* Culture-confirmed cases with drug susceptibility results available
† Resistance to at least one first-line anti-TB drug [i.e., isoniazid (INH), rifampin (RIF), pyrazinamide (PZA), or ethambutol (EMB)]
** INH-resistant cases may also be resistant to other drugs
‡ Multi-drug resistant TB, defined as resistance to at least INH and rifampin (may also be resistant to other drugs)

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Drug-resistant TB is a serious public health concern globally, nationally, and in Minnesota. This slide presents drug susceptibility data among culture-confirmed TB cases reported in Minnesota from 2018 through 2022. Drug susceptibility testing is performed on all culture-confirmed TB cases reported in Minnesota unless an isolate is unavailable for testing. Among culture-confirmed TB cases, 14% were resistant to at least one first-line anti-TB medication [i.e., isoniazid (INH), rifampin (RIF), pyrazinamide (PZA), or ethambutol (EMB)]. This includes 11% of cases who were resistant to at least INH and 4% who were multidrug-resistant (MDR-TB), which is defined as resistance to at least isoniazid and rifampin, two of the most effective TB medications. There were no cases in this time period with extensively drug-resistant TB (XDR-TB), which is a type of MDR-TB with additional resistance to any fluoroquinolone and at least one of three injectable second-line medications.

Multi-drug Resistant TB (MDR TB) Minnesota, 2018-2022



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This slide shows the total burden of MDR TB in Minnesota in the past 5 years. For surveillance purposes, only drug-susceptibility testing results from initial cultures count towards official cases reported to CDC as MDR TB as depicted in the previous slide. Additional MDR TB patients included in this slide that did not meet CDC's surveillance criteria ("burden cases") include: cases who are treated for "presumed" MDR TB, primarily young children who are contacts to MDR TB cases and cannot produce adequate respiratory specimens; "acquired" MDR TB, cases who develop resistance due to inadequate treatment during therapy for active TB; and "non-countable" cases who were reported by another jurisdiction and moved to Minnesota during treatment or were on TB treatment within the 12 months prior to their most recent TB diagnosis (termed "relapse" cases). Non-countable cases are not reflected in Minnesota's reported case numbers elsewhere throughout this slide set.

TB Cases by Drug Susceptibility Patterns and Place of Birth Minnesota, 2018–2022

Place of birth	Cases With Susceptibility Results*	Any Drug Resistance† No. (%)	INH-Resistant** No. (%)	MDR-TB‡ No. (%)
Non-US-Born	467	69 (15)	53 (11)	19 (4)
US-Born	80	9 (11)	7 (9)	4 (5)
Total	547	78 (14)	60 (11)	23 (4)

* Culture-confirmed cases with drug susceptibility results available

† Resistance to at least one first-line anti-TB drug [i.e., isoniazid (INH), rifampin (RIF), pyrazinamide (PZA), or ethambutol (EMB)]

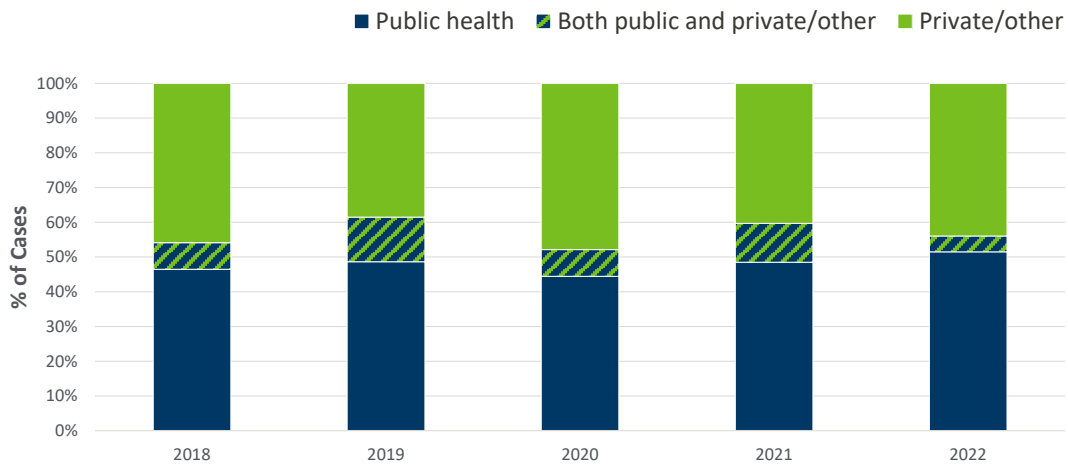
** INH-resistant cases may also be resistant to other drugs

‡ Multi-drug resistant TB, defined as resistance to at least INH and rifampin

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Among culture-confirmed TB cases reported in Minnesota from 2018 through 2022, non-US-born cases were **1.4** times more likely than US-born cases to have resistance to any first-line anti-TB drug and **1.2** times more likely than US-born cases to be resistant to isoniazid (INH), in particular. In 2022, the national percentages of cases with at least INH-resistant TB for non-US- and US-born were 9% and 6%, respectively.

TB Cases by Type(s) of Provider* Minnesota, 2018-2022



* Some patients are managed by multiple providers throughout disease course

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As mentioned previously, the three public TB clinics that manage patients with active TB disease are located in Hennepin, Ramsey and Olmsted counties. From 2018 to 2022, 57% of all TB patients were followed by at least one of these public clinics at some point in their disease course, while 43% were followed solely by private clinics or hospitals, or, less commonly, by Veteran Administration hospitals, correctional facility medical staff, or Indian Health Service. In 2022, the percentages were 56% and 44%, respectively.

TB Cases by Mode of Treatment Administration Minnesota, 2018-2022

Year	Started treatment	At least some DOT*	Completely self-administered
2018	170	98%	1%
2019	146	100%	0%
2020	115	99%	<1%
2021	129	99%	<1%
2022	130	99%**	0%
Total	690	99%	<1%

Type of Provider	Started treatment	At least some DOT*	Completely self-administered
Public	397	100%	0%
Private only	293	99%	1%

*DOT = Directly Observed Therapy

**Treatment administration unknown for 1 case.

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The last two slides present data on the treatment of TB cases in Minnesota.

This slide presents the mode by which TB treatment was administered for TB cases reported in Minnesota from 2018 through 2022. Over 99% of cases received at least some portion of their TB medication through Directly Observed Therapy (DOT). DOT, which involves having a health care provider or trained outreach worker observe a TB patient taking each dose of TB medications, is the recommended standard of care for the treatment of TB disease. During this five-year period, at most only <1% of TB cases reported each year self-administered their entire course of TB treatment. The widespread use of DOT in Minnesota is facilitated by the work of the local and tribal public health nurses in each county who are primarily responsible for administering DOT for TB cases in their jurisdictions.

Local and tribal public health departments throughout Minnesota provide DOT at no cost, regardless of whether the patient is being treated by a private or public provider. This slide illustrates that, among TB cases reported in Minnesota from 2018 through 2022, the use of DOT was more common among patients who received treatment for TB disease at public health clinics than among patients who received TB treatment exclusively from private clinicians. Treatment for 1% of TB cases managed by private providers was exclusively self-administered, whereas no cases treated at public TB clinics received self-administered therapy exclusively.

Treatment Completion and Length of Therapy Among TB Cases Minnesota, 2017-2021 as of February 16, 2024

Year	Started Treatment*	Completed Within 12 mos.** No. (%)	Completed Overall** No. (%)
2017	138	132 (96)	138 (100)
2018	139	128 (92)	135 (97)
2019	114	102 (89)	110 (96)
2020	93	85 (91)	92 (99)
2021	102	90 (88)	96 (94)
Total	586	537 (92)	571 (97)

* Patients for whom < 12 months of therapy is indicated. This excludes patients with rifampin resistance, meningeal TB, TB in bone or skeletal system, TB in CNS, children 14 years of age or younger with disseminated TB, patients who died or moved out of US within 366 days of starting treatment.

** Treatment completion data as of 8/29/2022.

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This last slide presents the outcome of treatment for the TB cases reported in Minnesota from 2017 to 2021 for whom 12 months or less of treatment was indicated (2021 is the most recent annual cohort of patients for whom data on treatment outcome is complete). This slide excludes patients with rifampin-resistant or meningeal TB, TB in the bone or central nervous system, and pediatric patients with disseminated TB, all of whom require a longer course of treatment. It also excludes patients who died or moved outside of the U.S. within one year of starting treatment. While most uncomplicated cases of TB disease are eligible for 6-9 months of treatment, the Centers for Disease Control and Prevention (CDC) has established an objective of 95% of TB cases completing adequate therapy within 12 months by 2025, which allows a margin of error for the often unavoidable obstacles that can prolong therapy.

These data indicate that the great majority (92%) of eligible TB cases reported in Minnesota from 2017 to 2021 successfully completed an adequate course of treatment within one year, very close to meeting the CDC objective for 2025. When looking at whether these eligible cases have ever completed a full course of TB treatment, regardless of duration, the proportion increases to 97%.